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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of) Art Unit: unknown
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 Richard D. Haney) Examiner: unknown
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Serial No. unknown) Docket No: PRC-001
))
Filed: herewith)

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09/613004
07/10/00

For: WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE

Box Patent Application

Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

TRANSMITTAL LETTER FOR NEW PATENT APPLICATION

Sir:

Enclosed for filing please find a new Patent Application entitled WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE filed on behalf of Richard D. Haney including (29) pages of specification (including claims and abstract), and having (5) independent claims and (5) total claims, a 1 page abstract, and having (3) sheets of informal drawing figures comprising Figures 1-4, an original signature signed Declaration for Patent Application signed by Richard D. Haney, an original signature signed Verified Statement Claiming Small Entity Status signed by Richard D. Haney on behalf of Pacific Resources Communications Corporation, Appendix A consisting of (2) pages, Appendix B consisting of (1) page, Appendix C consisting of (2) pages, Appendix D consisting of (1) page, a check for the fees calculated below (\$423.00), and a return postcard. The attorney's Docket Number is PRC-001.

Fees:

Basic Small Entity Filing Fee:	\$345.00
Extra Independent Claims Fees in excess of three (2 x \$39) extra Independent Claims	\$78.00
Claims in Excess of 20 Total Claims (0 x \$9):	<u>\$00.00</u>
TOTAL	\$423.00

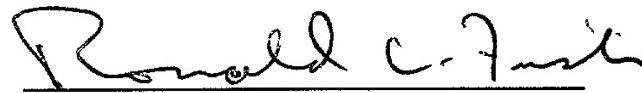
Small Entity filing fees apply as there is enclosed herewith a Declaration.
Claiming Small Entity Status signed by an officer of the Assignee enclosed herewith.

Kindly address all communications regarding this application to:

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The Commissioner is authorized to charge any shortfall in fees and any fees necessary at any time to keep this case from becoming abandoned to deposit account 06-0932, or to credit any overpayments to deposit account 06-0932.

Respectfully submitted,



Ronald Craig Fish
Reg. No. 28,843

Dated: July 10, 2000

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail in an envelope addressed: Commissioner of Patents and Trademarks, Washington D.C. 20231 on (Date Of Deposit) July 10, 2000
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Ronald Craig Fish, President
Ronald Craig Fish a Law Corporation
Reg. No. 28,843

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

) Art Unit: unknown

)

Richard D. Haney

) Examiner: unknown

)

Serial No.: not yet assigned

) Docket No: PRC-001

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Filed: herewith

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For: WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE

BOX PATENT APPLICATION

Honorable Commissioner
of Patents and Trademarks
Washington, D.C. 20231

VERIFIED STATEMENT (DECLARATION) CLAIMING
SMALL ENTITY STATUS (37 C.F.R. 1.9(f) and 1.27(c))
SMALL BUSINESS CONCERN

I hereby declare that I am

- the owner of the small business concern identified below:
- an official of the small business concern identified below and empowered to act on its behalf.

NAME OF BUSINESS: Pacific Resources Communications Corporation

ADDRESS OF BUSINESS: 4709 Michelle Way, Union City, CA 94587

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed, to and remain with the small business concern identified above with regard to the invention, entitled:

WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE

by inventor(s): Richard D. Haney

described in:

- the specification filed herewith
- application Serial No. _____, filed _____.
- patent No. _____, issued _____.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below and no rights to the invention are held by any person, other than an inventor who qualifies as an individual inventor pursuant to 37 C.F.R. §1.9(c), who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).*

*Note: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27).

FULL NAME:

ADDRESS:

Individual Small Business Concern Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which the verified statement is directed.

Richard D. Haney

President

Name of Person Signing

Title of Person Signing

4709 Michelle Way, Union City, CA 94587

Address of Company

Signature

7-10-2000

Date

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Ronald C. Fish

Ronald Craig Fish, President
Ronald Craig Fish a Law Corporation
Reg. No. 28,843

WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE

By
Richard Haney

Field of use and Background of the Invention

The invention is useful in providing wide area networking services to clients with many locations among which data, especially high volumes of data, must be sent.

The prior art of WANs include frame relay and point-to-point networking offered by telephone companies. One type of Wide Area Network (WAN) service provided by telephone companies is leased lines. These may be analog or digital and are provided typically by a Local Exchange Carrier (LEC) on an intraLATA basis (Local Access and Transport Area). InterLATA leased lines are also available but must be provided by an Interexchange Carrier (IXC) with the LEC providing the local loop connection.

Another such WAN service is known as a Virtual Private Network. A VPN is intended for use by very large organizations with multiple locations. A VPN appears to the user as if it was private leased line trunk network, but it is not. VPN services are generally arranged with an Interexchange Carrier (IXC) with the points of the network termination (locations from which data will be sent and received being identified along with the level of bandwidth required at each termination. Dedicated circuits (telephone lines) are established between each network termination and the closest capable IXC POP (Point of Presence). Connections between POPs are not dedicated but are established by routers using routing tables to route the traffic over specified high-capacity transmission facilities on a priority basis to ensure the level of service provided is adequate and equivalent to a true private network using leased lines.

Other forms of Public Data Networks include: DDS, Switched 56 Kbps; Digital T-Carrier Systems; Digital 800 Services; X.25 Packet Switched Services; Broadband Data Networking such as Frame Relay and Cell Switching, ADSL, HDSL, Sonet, Switched Megabit Data Services, ISDN and Advanced Intelligent Networks.

Dataphone Digital Service (DDS) which was introduced by AT&T in 1974 and is generally end-to-end, fully digital, dedicated service provided by most carriers. DDS may be either point-to-point or multipoint. A head end Front End Processor controls all access

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to the network by polling remote devices. All communication must pass through the head end. DDS signals are carried within logical channels on T1 lines.

Switched 56 Kbps is a circuit switched (rather than dedicated line) digital service that serves the same applications as DDS although it is more cost effective for lower data volumes. All the components are the same as DDS but digital local loops and digital carrier exchanges are used. The main difference over DDS is that traffic is routed using a logical address which is the equivalent of a voice telephone number. The circuit is set up, maintained and torn down much like a voice call is switched and pricing is similar. The cost is sensitive to distance, duration, time of day and day of the year.

Digital T-carrier systems (including fractional T1 service) are dedicated links carry digital data over multiple logical channels on a single physical communication circuit with the logical channels established by time division multiplexing.

Digital 800 service was introduced in 1994 by AT&T and is intended for medium to high volume customers subscribing to high volume 800 service offerings.

X.25 packet switching was invented in the early 60's and was implemented on ARPANET in 1971. X.25 is a dial up service as is ISDN and Switched 56/64 Kbps WANS, and, as such, is not suitable for dedicated WANs such as the WANs in the AlterWAN™ network genus of the invention. The basic concept of packet switching provides a highly flexible, shared network in support of interactive computer communications in a WAN. Prior to packet switching, users spread over a wide area with only infrequent traffic had no cost effective way of sharing computer resources. Asynchronous communications are bursty in nature and send only small amounts of data with lots of idle time between bursts. Having dedicated lines for such communication is a waste of bandwidth and expensive. Packet switching solved those problems by providing connections as needed which were billed on the number of packets transmitted. Packet switching also improved the error performance. Typically a packet switched network uses a dial up connection to a packet switching node. Once the connection to packet switching node is made, a control packet is sent to establish the session with the target host. The control packet is forwarded across the most direct link that is available in a number of hops between nodes. The target host responds with a control packet sent back to the source to establish the session. Each packet is numbered sequentially and transmitted. ISDN is an entirely digital suite of dial-up data communication services delivered over the twisted pair local loop. ISDN lines have B channels that carry

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information, D-channels that carry data for signalling and control, H-channels that carry high speed data for bandwidth intensive applications. It has been a commercial failure.

Frame relay networks were first deployed in the mid 90's and is somewhat like packet switching in that each frame is individually addressed. Frame relay makes use of special switches and a shared network of very high speed. Unlike packet switching, frame relay supports the transmission of virtually any computer data stream. Frames are variable in length up to 4096 bytes. Frame relay is data oriented and does not support voice or video very well. As is the case for X.25 packet switching, frame relay overhead is high and delays in transmission are expected. Further, network congestion can result in loss of data. Although frame relay networks appear to the customer to be one-hop networks, they really are not one hop nets. There are many links between multiple Central Office (CO) switches inside the typical frame relay cloud. Each hop adds latency and the possibility of running into bandwidth congestion. Further, frame relay networks cannot cross telephone company boundaries so all sites on a frame relay WAN must be using the same frame relay provider, i.e., it not possible for some sites to be coupled to AT&T frame relay COs and other sites to be coupled to MCI or Spring COs. Every frame has a DLCI code in the header that identifies the customer and the virtual data path through a particular telephone company for the traffic. Therefore, it is not possible to mix frames with different DLCIs because different telco DLCIs have different formats and that will disrupt the routing process for such frames through the CO switches. If two locations on a frame relay network cannot both be served by the same frame relay provider, a second frame relay cloud must be built and the two clouds connected together by two routers at some common location that can be coupled to both clouds with the two routers coupled together by a local area network.

Cell switching has been conventionally thought to be the future of data communication networks. Cell switching encompasses both ATM networks and Switched Multimegabit Data Service (SMDS). Data is organized into cells of fixed length of 53 octets and are shipped across high speed facilities and switched in high speed, specialized switches. ATM is primarily data oriented, but is supports voice and video effectively. Cell switching is high cost and has high overhead and suffers from a lack of fully developed standards. ATM networks are also not widely commercially available yet.

The problem with all these approaches is that they are expensive with recurring telephone company charges.

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The internet as a backbone has recently loomed as a possibility for implementing wide area networks and lowering the cost. However, there are several problems with using the internet as a WAN backbone. Generally, these problems all relate to quality of service.

5 Quality of service has to do with both errors in transmission as well as latency. Latency or delay on critical packets getting from source to destination can seriously slow or disrupt operations of computer systems. Latency can also destroy the efficacy of streaming video, streaming audio and streaming multimedia product and service delivery by causing visible and/or audible gaps in the presentation of the program encoded in the data to the user or freezes. This can be very distracting and undesirable in, for example, video conferences,

10 video-on-demand, telephone calls etc. Latency is also a problem when large documents are being downloaded because it slows the process considerably. Latency arises from multiple hops between nodes on the internet coupling the source to the destination.

Prior art attempts to use the internet as a backbone did not control the number of hops and available bandwidth in the data path from source to destination. As a result the number of router hops along the route and the lack of available bandwidth precluded the use of the internet as a viable private network backbone alternative. ISP's built local businesses without regard to the customers regional, national or international presence as their objective was only to offer LOCAL internet access. This resulted in attempts to use the internet as an alternative private network backbone of routes that may have few hops or many hops. Routes that may have inadequate bandwidth for the worst case bandwidth requirement of a WAN were sometimes picked and that resulted in failure. This uncontrolled hop count, and lack of control of the data paths and the available bandwidth and the resulting latency caused problems in implementing WANs on the internet.

Another major problem with using the internet as a backbone is security or privacy.

25 Since the internet is a public facility, private and sensitive data transmitted over the internet is subject to snooping.

Thus, there has arisen a need for a system which can use the internet as a WAN backbone to help decrease the costs of data transport while not suffering from the aforementioned latency, privacy and bandwidth availability problems.

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Summary of the Invention

The wide area network technology described herein (referred to as AlterWAN™ network) is an alternative wide area network that uses the internet as a backbone with any telephone company providing the local loop connection to the first participating ISX/ISP and any telephone company providing a local loop connection from the endpoint participating ISX/ISP to the destination router. This greatly reduces monthly costs to customers and removes the frame relay restriction that the same telephone company must provide all data paths including the local loops at both ends. High quality of service is maintained by mimicking the “one hop” private network structures of prior art frame relay and point-to-point networks. Any WAN that uses the internet as a backbone and mimics the “one hop” structure of private frame relay and point-to-point networks by any means is within the genus of the invention.

A key characteristic that all species within the genus of the invention will share is a tuning of the internet network routing process by proper ISX selection to reduce the hop count thereby reducing the latency problem that has plagued prior failed attempts to use the internet as a WAN backbone.

Another key characteristic that all species within the genus of the invention will share is the transmission of secure encrypted data along preplanned high bandwidth, low hop-count routing paths between pairs of customer sites that are geographically separated. The encrypted AlterWAN data is sent through a high bandwidth, dedicated local loop connection to the first participating AlterWAN ISX/ISP facility. There, the AlterWAN packets are routed to the routers of only preselected ISX facilities on the internet. The preselected ISX/ISP facilities are ones which provide high-bandwidth, low hop-count data paths to the other ISX/ISP facilities along the private tunnel. The routers of these participating ISX/ISP facilities are specially selected to provide these high-bandwidth, low hop-count data paths either by their natural routing tables or by virtue of special routing tables that these ISX/ISP providers establish to route AlterWAN packets through high-bandwidth, low hop-count paths and route other internet traffic along other paths. For example, if a customer site in San Jose needs to have AlterWAN service to another site in Tokyo, a “private tunnel” is built in each direction through the internet and two dedicated local loops, one at each end are established to connect the two customer sites to the first and last participating ISX providers in the private tunnel. Data security is implemented by the

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use of conventional or custom firewall/VPN technology. At each customer site, a firewall/VPN device is configured to securely encrypt the payload of each AlterWAN packet to be sent through a “private tunnel” to the far end customer site where the payload is decrypted. Using conventional firewalls, the encryption method and the encryption keys used at both ends for transmissions in both directions are the same. However, the invention also contemplates using one encryption algorithm and encryption key or keys for downstream transmissions and another encryption method and different key or keys for the upstream direction. This method may require the use of custom designed firewalls.

5 Whichever method is used, the firewalls at both ends use the same encryption method and key or keys for encryption of packets at the source and decryption of them at the destination by predetermined configurations that are programmed into the firewalls. Only packets identified at the source end firewall with a destination IP address at the other end of an AlterWAN “private tunnel” have the payload of the packet encrypted before being sent. Once they are encrypted, they are sent across the preplanned route to the destination where the far end firewall recognizes the IP address of the packet as being addressed to it. Only those 10 packets are decrypted and transmitted to the device to which they are addressed and other packets that are not AlterWAN packets are either rejected or routed to some other device 15 which is not part of the AlterWAN network.

In other words, the quality of service problem that has plagued prior attempts is solved by providing non-blocking bandwidth (bandwidth that will always be available and will always be sufficient) and predefining routes for the “private tunnel” paths between points on the internet between ISX facilities. Participating ISX facilities agree to provide non-blocking bandwidth between their sites. By having private tunnels to each location of a worldwide company for example, an engineer in San Jose can connect directly to a LAN at a branch office in Paris and “see” on his/her computer’s desktop all the shared items on the 20 Paris LAN such as various servers, printers etc.

This preplanning of the routing path causes traffic from AlterWAN™ customers to be transmitted quickly and without delay from end to end and not experience delays due to lack of bandwidth or excessive hop count. Because the packet payload is encrypted, the data is secure during its transport across the internet through the “private tunnel”. The 25 AlterWAN™ network design minimize the number of hops each AlterWAN™ network packet experiences in its travel from source to destination thereby reducing latency by causing 30

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AlterWAN™ network traffic to be routed only over high bandwidth lines coupling participating ISX/ISP providers. Recently, there has been a large amount of building of ISX internet providers having fiber optic data paths to other providers to provide large amounts of bandwidth. Typically, one or both of the routers at the source and destination of the
5 AlterWAN™ network can be co-located at the first ISX.

The privacy problem is overcome by firewalls provided in the AlterWAN™ network at every customer premises which are encrypting firewalls (preferred firewalls are commercially available from Netscreen). Every outgoing AlterWAN™ packet (AlterWAN packets are those packets which are encrypted and are transmitted along predefined routes
10 through the internet in "private tunnels") is encrypted by the firewall at the source using a preconfigured encryption algorithm although any encryption algorithm such as conventional DES encryption that uses a key will suffice. The encryption process requires the preprogramming of "private tunnel" identities and the associated encryption and decryption keys. The "key" is used by the firewall/VPN device for encryption and
15 decryption of the packet payload. Keys are preassigned for each "private tunnel" and are generated by the firewalls at each end from one or two passwords that are programmed into the firewall when the private tunnel is set up. Encrypted packets are routed over predefined paths. Packets intended for the general internet are not encrypted and are passed out to the
20 first ISX to find their way through the internet by the normal routing process. Each packet that is intended for a predefined private tunnel is encrypted and sent out through a dedicated high bandwidth local loop to the first ISX. From there it is routed along a predefined route established by proper selection of ISX providers.

The key can remain the same over time or change, but no packet encrypted without the current key for a particular tunnel can be decrypted at the destination. The keys are
25 never transmitted along the tunnels. They are configured into the firewalls by prearrangement at each end. Each tunnel has a different key.

A "private tunnel" is defined as the data path through the internet from the source firewall to the destination firewall through the predefined, low hop count, high bandwidth path. The private tunnel is established by proper selection of ISX providers. This is done by
30 studying the normal routing paths used by all the ISX providers between a pair of customer sites to be connected by the tunnel. Then ISX providers which normally route along high bandwidth links with a minimum hop count are selected to participate. When AlterWAN

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packets reach these ISX providers, the normal routing that occurs there results in the AlterWAN encrypted packets travelling along a high bandwidth low hop count path.

The ability of firewalls to encrypt and decrypt is known and commercially available and is simply being used in the AlterWAN network. Browsers at workstations at customer 5 AlterWAN sites however can be pointed to any website on the internet and can send and receive packets to and from those sites without restriction. Those packets are referred to herein as conventional packets, and they get to their destinations by conventional internet routing and do not pass through the private tunnels created by the AlterWAN data structures.

The AlterWAN data structures really are just IP addresses and associated data in the 10 firewalls and routers along the tunnel that cause the packets to travel the low hop count path. The AlterWAN data structures will vary from customer to customer depending upon which sites are to be linked and the locations and IP addresses of the participating ISX/ISP providers through which the hops of the private tunnel will pass.

Finally, all species in the genus of the invention will solve the bandwidth bottleneck 15 that has plagued prior attempts to use the internet as a WAN backbone. This is done by implementing AlterWAN™ routing strategies. An AlterWAN data path extends from a source router (having a channel service unit to interface between the packet world of routers to the physical and media access control and/or signalling protocols of the telephone line) through a sufficiently high bandwidth dedicated local loop line to the first participating ISX or 20 Internet Service Provider (ISP) that is a participating provider of AlterWAN™ network services. From there it extends along a data path between other participating ISX providers along a data path which is guaranteed to have sufficient bandwidth to be able to handle the worst case bandwidth consumption of the customer. In the claims, such an ISX or ISP provider is referred to as a “participating ISX/ISP”. All the ISX or ISP facilities that are 25 participating in the AlterWAN™ network structure have fiber optic or other high bandwidth data paths such as OC3 or OC12 data paths available to them to send data to other ISX/ISP facilities that are participating in the AlterWAN™ network. It is these high bandwidth links which are referred to as “core bandwidth” between participating ISX/ISP facilities. It is 30 this core bandwidth over which AlterWAN™ “private tunnel” traffic is routed on the internet backbone.

The dedicated lines from the source router at the customer premises to the nearest participating ISX/ISP is typically T1 class or better in bandwidth, but it only needs to have

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two characteristics: it must be dedicated and not dialup; and, it must have sufficient bandwidth capacity to handle the worst case bandwidth consumption of the particular client facility it serves. Such a line is referred to in the claims as a "dedicated line". Thus, the dedicated lines from the source router to the nearest participating ISX/ISP may also be DSL or fractional T1.

The "participating ISX/ISP" to which the "dedicated line" couples may not be the nearest ISX/ISP since it is a rule of the AlterWAN™ network to only choose ISX/ISP facilities that restrict the loads in their data paths so as to have large amounts of spare bandwidth capacity. For example, AboveNet typically has loads of 50% or less in their high bandwidth data paths to other ISX facilities. Therefore, AlterWAN™ network species will all have their dedicated connections to ISX/ISP facilities that have lots of spare bandwidth capacity and definitely more than the anticipated worse case bandwidth consumption of the customer so there is never a bandwidth bottleneck even if that ISX/ISP facility is not the closest facility. Although the local loop costs will be higher in such situations, the savings by using the internet as a backbone without quality of service problems will greatly outweigh the burden of higher local loop costs.

The use of the dedicated lines to the nearest participating ISX/ISP and selection of only ISX/ISP facilities that limit the traffic in their data paths so as to have a great deal of spare capacity are the two characteristics of all AlterWAN™ network species which solve the prior art bandwidth bottleneck problems.

The above described structure controls the three major unpredictability factors that have frustrated prior workers in the art who have attempted to use the internet to implement WANs: hop count, bandwidth availability, and latency. The advantages of the AlterWAN™ network structure and operation are: large savings in Telco charges.; clean implementation of security not requiring PC or workstations to load special client software; use of ISX core internet bandwidth with sufficient bandwidth available for worst case scenarios and with a robust fault tolerant infrastructure; the ability to offer full or partial turn-key solutions to WAN needs; local loops may be a mix of different services and speeds from different providers; an apparent one hop route to each location; customer access to local router and firewall; both public and private IP addressing can be used; communications are secure through secure tunnels using encrypted packets; and not need to rely on quality of service software processes at either end to get data, voice and video through since the

AlterWAN network controls hop count, latency and bandwidth availability inherently by its structure and operation.

Brief Description of the Drawings

5 Figure 1 is a block diagram of a WAN using the internet as a backbone according to the genus of the invention.

Figure 2 is a block diagram of the actual hardware used in a typical AlterWAN network.

Figure 3 is a logical view of an AlterWAN private tunnel.

10 Figure 4 is a block diagram of a typical AlterWAN network for a U.S. headquarters coupled to several international sites.

Detailed Description of the Preferred and Alternative Embodiments

Typically 60-80% of wide area network costs over a five year period are recurring telephone company charges for their frame relay and point-to-point networking services. These charges break down into: local loop charges to have the connection; a distance charge depending upon the distances between nodes; and, a bandwidth charge for the minimum bandwidth the customer specifies. These costs can typically be drastically reduced by using the internet as a WAN backbone, but only if the latency and other quality of service problems that have plagued prior art attempts can be solved. These costs can be drastically reduced over frame relay and point-to-point networks even if extra costs of crossing telephone company boundaries are not incurred. The AlterWAN™ network of the invention does not have any telephone company boundary problems to overcome.

Referring to Figure 1, there is shown a block diagram of a wide area network species within the genus of the wide area networks using the internet as the backbone with controlled, small hop count, reduced latency and adequate bandwidth for the worst case scenario. A work station 10 (or server or any other peripheral) is typically coupled to an encrypting/decrypting firewall 12 by a local area network represented in this case by a LAN hub or switch 14. The work station 10 or other device may also be coupled to the firewall 12 by a dedicated line in alternative embodiments, and there may be more than one workstation or other device coupled to the firewall 12 either by LAN 14 or by individual dedicated lines. The preferred firewall is manufactured by Netscreen, but any

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encrypting/decrypting firewall that uses a customer defined key to encrypt each AlterWAN™ packet that has an IP destination address at the end of an AlterWAN private tunnel will suffice.

The function of the firewall, in one embodiment, is to receive and encrypt downstream packets addressed to nodes at the destination site on the AlterWAN network and to receive conventional internet protocol packets (hereafter IP packets) addressed to some other IP address on the internet and distinguish them from AlterWAN packets and not encrypt them. Both AlterWAN and conventional IP packets are sent to the firewall from the workstation 10 or other peripherals at customer site 1, shown in dashed lines at 20. One function of the firewall 12 (and the corresponding firewall 40 at the destination) is to distinguish between AlterWAN packets and conventional IP packets. AlterWAN packets are those packets which are addressed to destinations at the end of an AlterWAN private tunnel. Conventional packets are IP packets addressed to any other IP address other than an address at the other end of an AlterWAN private tunnel. The firewall at each end of a private tunnel are configured to encrypt AlterWAN packet payloads and send them to a router at the location of firewall from which they are converted to a suitable signal format for transmission on a dedicated local loop connection and transmitted to the first ISX/ISP provider along predefined high bandwidth, low hop-count private tunnel through the internet. Conventional IP packets are not encrypted and are sent to the router and on the same dedicated local loop connection to the first participating ISX/ISP where they are routed to their destinations without using the private tunnel high bandwidth, low hop-count route. The firewalls make this distinction by examining the packet headers and using the destination address information and one or more lookup tables to determine which packets are AlterWAN packets addressed to nodes on the AlterWAN network and which packets are addressed to any other IP address outside the AlterWAN network.

More specifically, at each end of a private tunnel, a packet addressed to any of the IP addresses of devices at the other end of a private tunnel are recognized as packets that need to be converted to AlterWAN packets, encrypted by the firewall and encapsulated in another IP packet having as its destination address the IP address of the untrusted side of the firewall at the other end of the private tunnel. The composite AlterWAN packet is comprised of the encrypted original IP packet with an AlterWAN packet header which has as its destination address the IP address of the untrusted side of the destination firewall. At the firewall at the

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other end, these incoming AlterWAN packets will be recognized because their destination addresses match the IP address of the untrusted side of the firewall. The firewall then strips off the AlterWAN packet header of the encapsulating packet and decrypts the original IP packet that was encapsulated using the same encryption algorithm and key or keys that were used to encrypt it. The decrypted packet then has an IP packet header which has a destination address which matches the IP address of some device on the LAN on the trusted side of the destination firewall. The decrypted packet is then put on the destination LAN and makes its way to the device to which it was addressed.

The main function of the firewall is to encrypt the payloads of only AlterWAN packets with customer defined key or keys which are configured to be the same in the firewalls at both ends of the tunnel. In the preferred embodiment, commercially available firewalls are used which are configured to use the same encryption algorithm and encryption keys at both ends of each tunnel for packets travelling in either direction along the tunnel. However, in alternative embodiments, firewalls may be used which use one encryption algorithm and set of one or more encryption keys for packets travelling in one direction along the tunnel and another different encryption algorithm and/or a different set of keys in the firewalls at each end of the tunnel for packets travelling in the opposite direction. The corresponding firewall/VPN device at the tunnel far end must be programmed with the exact same key used to encrypt the packet to decrypt the packet. The encrypted packet is tested with the local key to decrypt the packet. If a match exists, the packet is decrypted and allowed through the firewall/VPN device. If not, it is discarded. Many firewalls set the encryption method and key the same for both directions of a private tunnel. In the event a firewall/VPN device implements a private tunnel by using a different encryption method and or key for each half of a private tunnel, and that both firewall/VPN devices are configured properly, they may be implemented and used in an AlterWAN network solution. The key can be the same for all AlterWAN packets over time or it can change over time. Any encryption algorithm capable of doing this will suffice. Any conventional IP packets are not encrypted by the firewall and are simply forwarded to a router such as source router 18 or destination router 42.

The firewalls 12 and 40 are typically coupled by another local area network line to a router at the source or destination site. For example, firewall 12 is coupled by LAN line 16 to a router 18 at customer site 1, and firewall 40 is coupled by a LAN line 44 to destination router 42. Routers 18 and 42 each function to route AlterWAN and conventional IP packets

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differently. Both routers 18 and 42 route any AlterWAN packet into a “private tunnel” of a dedicated high bandwidth local loop data path 22 which guides these AlterWAN packets to the first participating ISX/ISP 24 in the AlterWAN™ network. The first and last participating ISX/ISP providers also have channel service units represented by boxes 23 and 25. Any
5 conventional IP packets are also routed into dedicated data path 22, but these conventional data packets are not part of the AlterWAN private tunnel because their destination addresses are not the address of the destination at the other end of the tunnel. Each of routers 18 and 42 includes a channel service unit, as shown at 19 and 21. These channel service units convert the digital data of the packets into signals suitable for transmission on whatever
10 type of dedicated local loop signal path 22 and 46 are selected. The local loop dedicated signal paths 22 and 46 do not need to be the same type of signal path at both ends so long as suitable channel service units or cable modems are selected for CSUs 19 and 21.

The dedicated line 22 is typically a T1 class, partial T1 or DSL line or better with adequate bandwidth in both directions to meet the worst case bandwidth consumption
15 scenario. DSL lines are typically not preferred since they typically only have about 640 Kbps bandwidth upstream to the CO even though they have 1.544 Mbps downstream or better. There are however some ADSL variations with up to 5 Mbps upstream and 51.84 Mbps downstream from the CO to the customer sites. One variant of ADSL supports 15 Mbps upstream and 155 Mbps downstream, but the customer ADSL modem must be within 500
20 meters of the central office so such a line is highly impractical unless the AlterWAN customer site is virtually at the CO. Since the AlterWAN™ network is bidirectional and must have sufficient bandwidth on all data path segments thereof to meet the worst case scenario, DSL lines typically cannot be used unless the worst case scenario does not exceed the DSL line upstream bandwidth specification. Also, for DSL lines, the CO must be within
25 about 2 miles (0.6 to 1.2 miles for the higher speed variants) from the customer site and this restriction can rule out their use if a deal with a participating ISX/ISP within that range cannot be made.

Each of routers 18 and 42 have a channel service unit (not separately shown) built
30 into the router (or external). The function of these channel service units in the local loop is to electrically and physically convert the (LAN) ethernet data to the signalling protocols and signal format of the telco on whatever dedicated lines 22 and 46 are chosen. The dedicated lines can be different (telephone lines or hybrid fiber coax of a CATV system or digital cable

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or satellite bidirectional links) and can be provided by different vendors. For example, if the dedicated line 22 is a T1 line the channel service units converts the AlterWAN packet data into signaling compatible with the chosen telco and transmission of that data to the matching CSU/router at the other end of the local loop where the signal is converted back to
5 a format acceptable for processing by the router at the ISX. If the dedicated line is the hybrid fiber coaxial digital cable of a CATV system using frequency division multiplexing or code division multiplexing or discrete multitone modulation, the channel service unit modulates the ethernet onto the proper FDMA carriers or spreads the spectrums for transmission across the “local loop” with the spreading codes dedicated to the AlterWAN
10 connection. This interfacing is bidirectional between the signal formats and protocols on dedicated lines 22 and 46

Routers 18 and 42 are the translators of the AlterWAN™ network private tunnel. The routers translate from ethernet protocol to the telco protocol on the dedicated lines 22 and 46. Other conventional IP packets that reach router 18 are routed along the same physical path and the dedicated lines but really are on a different logical path. Their payloads are not encrypted and they are not sent through the “private tunnels”. AlterWAN packets addressed to different destinations will be routed into the proper private tunnels of the AlterWAN network set up for those destinations. In some embodiments, conventional IP packets will be blocked by router 18 from entering the private tunnel or any other logical channel of the dedicated lines 22 and 46. Data path 26 leaving router 18 is a DMZ path and is optional. Likewise, destination router 42 includes a DMZ port 27. The DMZ path can be any other data path that is not part of the AlterWAN network, and is typically where mail servers reside.

One of the side effects of having the high speed dedicated line 22 is that workstations
25 at the client facility 1 (and the client facility at the other end of the WAN) can also have high speed internet access to other websites that have nothing to do with the AlterWAN solution without a separate connection. The AlterWAN traffic on dedicated line 22 shares this transport with non-AlterWAN traffic so it is important that the bandwidth on this dedicated local loop meet the aggregate needs of both AlterWAN traffic and conventional traffic. As
30 part of this process, packets that are not AlterWAN packets are recognized by the firewall by looking at the addressing information in packet header information and are not encrypted. Conversely, packets that appear to the firewall to be addressed to nodes in the AlterWAN

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network have their packet payloads encrypted. All the packets are then sent to the source router 18 (or destination router 42) which routes them. Conventional packets get routed on dedicated line 22 other than the AlterWAN private tunnel to the first participating ISX/ISP 24. At the first ISX/ISP 24 in the AlterWAN network, these conventional packets
5 get routed out one of the data paths represented by lines 27 through 36 that couple router 24 to the rest of the internet. This provides high speed access to other web pages and websites and e-mail services as a byproduct of the AlterWAN hardware and software processing.

AlterWAN packets get routed at the first ISX/ISP 24 into a high bandwidth data path
10 50 to the next participating ISX/ISP 48 in the AlterWAN network. Data path 50 is selected for the AlterWAN packets by the preselected ISX/ISP and peer level predefined routing between participating ISX/ISP's. This allows AlterWAN traffic to be transported between locations utilizing the naturally existing routes but those routes are selected so as to be high bandwidth and low hop count. Each router in the participating ISX/ISP facilities connects
15 and communicates in the same fashion. AlterWAN networks, by design, require selection of the ISX/ISP partners for any given network based on many factors including the ease of implementation by utilizing naturally occurring or other existing high bandwidth, low hop count routes. AlterWAN designers pretest these routes by performing a minimum of a ping test and traceroute test to verify the path data that AlterWAN packets will take through the
20 private tunnel that is to be implemented as an AlterWAN connection. AlterWAN partners do not normally need to add special routes, but implementing AlterWAN network designs that follow existing known paths does not preclude the addition of special routing from time to time as needed to afford better routing. By such a process, an AlterWAN network does not require each participating ISX/ISP to make alterations to their equipment for each "private
25 tunnel" created but rather transparently utilizes the high bandwidth peer level connections between ISX/ISP's. However, the invention does not preclude use of ISX/ISP providers who have altered their routing tables so as to insure that AlterWAN packets get routed along high bandwidth, low hop-count data paths while non-AlterWAN packets get routed along other data paths. Participating ISX/ISP's are selected in part based on their ability to use these
30 natural routes to form low hop count connections between the ends of an AlterWAN private tunnel or by entering into a special deal with one or more other participating ISX/ISP's to implement special peering arrangements and/or routing between each other to allow only

AlterWAN traffic to use these special low hop count high bandwidth connections forcing non AlterWAN traffic to follow other natural routing that does not provide the bandwidth and or hop counts that meet the AlterWAN requirement.

In the example of Figure 1, only three participating ISX/ISP providers are shown at 5 24, 48 and 54. The high bandwidth paths are the naturally occurring data paths that result from the routing tables in the participating ISX provider routers. These data paths are represented by lines 50 and 56. The private tunnel between customer site #1 at 20 and customer site #2 at 58 is implemented by the dedicated lines 22 and 46 and the high 10 bandwidth data paths 50 and 56 selected for AlterWAN packets by the routing tables in participating ISX/ISP providers 24, 48 and 54.

When AlterWAN packets from customer site #1 reach endpoint ISX/ISP router 54, they are routed onto dedicated line 46 to the channel service unit of destination router 42. The destination router 42 recovers and reassembles the ethernet packets and outputs them to firewall 40. Firewall 40 decrypts all AlterWAN packets with its local matching key 15 preconfigured on the firewall/VPN device and formats them to the LAN protocol. It then forwards them to the destination LAN hub or switch 60 where they are sent out on LAN 62 addressed to whatever peripheral 64, 66 or 68 to which they are destined. AlterWAN packets from any of these peripherals addressed to any of the peripherals at customer site 20 #1, 20, are encrypted by firewall 40 and are routed back through the private tunnel to site 20 where they are decrypted by firewall 12 and forwarded to LAN hub or switch 14 and sent out on LAN 70 to whatever peripheral at site 20 to which they are addressed.

FIREWALL AND TUNNEL SETUP

The firewalls 12 and 40 can be any commercially available firewall with the ability 25 to create a virtual private network. The firewalls serve two general purposes: they provide general security from unwanted access to the AlterWAN customer LAN network; and they provide private encrypted tunnels between a known set of sites even though the internet is a public facility. Each customer's AlterWAN network will be different based upon their needs in terms of the type and bandwidth of dedicated lines used and the private tunnel data paths 30 set up through the participating ISX/ISP providers between customer sites.

The interfaces of a firewall consist of an untrusted WAN interface, one or more trusted IP interfaces to dedicated lines or LAN drop lines, and a DMZ interface (if available).

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These three interfaces are illustrated at 72, 74 and 76, respectively, in Figure 2 which is a block diagram of the actual hardware configuration of a typical AlterWAN network. The untrusted or WAN interface is used to interface to the ISX/ISP premises router of the public internet, optionally through a customer premises router 18 or 42. The IP trusted interface 5 interfaces to the customer's private local area network 70 or 62 (or to dedicated lines to each peripheral in some embodiments). The DMZ interface (optionally available on some firewalls) is used to configure a separate network where devices that may need both public and private access typically are placed including WEB servers and e-mail servers.

Every LAN and WAN interface at both the customer premises and the ISX/ISP in 10 Figure 2 needs to be configured with IP addresses. The exception to this would be any LAN using a protocol different than ethernet IP such as Token Ring. In such case the proper networking and conversion equipment would be required. Each interface to be configured in general includes: an IP address, for example 204.123.111.150; a network mask, for example 255.255.255.0; and a default gateway, for example 204.123.111.1. The addressing for each interface is either supplied by the ISX/ISP or by the customer. The telephone (or cable system operator) high bandwidth dedicated lines 22 and 46 need to be in place and operational in addition to the configurations mentioned above to complete the 15 AlterWAN structure.

Tunnels and encryption methods vary between manufacturers of firewalls and 20 virtual private network (hereafter VPN) equipment. This limits the ability to mix products from different manufacturers within a specific customer's AlterWAN setup because the firewalls/VPN process at each end of each tunnel must use the same encryption algorithms so AlterWAN packets can be properly encrypted and decrypted. If however, all firewalls from all manufacturers can be modified to use the same encryption algorithm, then 25 firewalls/VPN processes from different manufacturers can be mixed and matched. The VPN processing hardware and software to encrypt and decrypt AlterWAN packets can be integrated into the firewall or external to it.

A virtual private network tunnel requires the following basic components and data structures at each end of the tunnel. There must be a virtual private network process 30 running on a VPN processor (can be the same processor as the firewall processor) or external to a firewall on each end of the private tunnel. The untrusted address of the far end VPN untrusted WAN interface must be configured in the VPN configuration data structure at

each end including a mnemonic label, an IP address and a network mask. The VPN configuration data structure at each end must also include a mnemonic label, an encryption key, an encryption type, an encryption password, and the gateway IP address of the far end firewall untrusted or WAN interface. Only when a VPN pair configured in this manner exists with one VPN on each end of a proposed tunnel, and the participating ISX/ISP providers route a path between the two endpoints over high bandwidth links with a minimum number of hop for AlterWAN packets, does the private tunnel actually exist. Once the tunnel is created, all the conventional internet routers and uncontrolled number of hops and uncontrolled latency that they create for non AlterWAN packets virtually disappear for AlterWAN packets. The AlterWAN data path logically appears to be a direct point-to-point connection between the two sites at opposite ends of the tunnel as shown in Figure 3.

Private tunnels are defined for each customer based upon the needs of that customer. This is done by identifying a set of known participating ISX/ISP locations through which the number of known hops caused by their routers is minimized. All locations on the internet outside this known set of sites and the associated networks are assumed to be general internet sites to which conventional IP packets can be directed.

The only real difference between a conventional IP packet and an AlterWAN packet is that the payload of the AlterWAN packet is encrypted Conventional packets have no encryption performed on the packet payload and are routed to the default gateway IP address of the participating ISP/ISX.

The firewalls at each end of each private tunnel prevent any unauthorized user from accessing the private LANs of AlterWAN customers. The tunnels in each firewall have configuration data that only allows specific user traffic access to the private tunnels. Traceroutes to any address outside the tunnel show all router hops for conventional packets while traceroutes to any address inside a private tunnel show only private tunnel hops for AlterWAN traffic. The establishment of a private tunnel enables users at a first customer site to appear to be directly connected to a LAN at another site of the customer so that all the shared resources on the other end of the tunnel appear on the desktops of the workstations at the first site. Most of the participating providers in AlterWAN structures are ISX providers. This eliminates the numerous hops customers typically incur in dealing with local ISPs for wide area networking. By picking participating ISX providers that have high bandwidth lines that are not fully utilized, the bandwidth availability problem of using the

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internet as a WAN backbone is solved. Numerous ISX providers now offer 1-hop connections to major cities in the U.S. and throughout the world. The AlterWAN network structure takes advantage of this fact by selecting the ISX/ISP's that form the shortest path(s) between the set of customer sites that need to communicate. Through this design and selection process, 5 the natural routes that stitch together these high bandwidth single hop lines with dedicated high bandwidth local loops to geographically separated customer sites to create a private tunnel through the internet between any two customer sites to provide frame relay quality service at substantially less cost.

Frame relay prior art WANs were considered highly desirable because they establish 10 permanent virtual circuits with known paths having known bandwidth. The internet has not been able to provide a similar solution in the prior art. The AlterWAN network structure changes that by creating virtual private circuits or tunnels through the internet using only lines that are known to have sufficient bandwidth to carry the worst case load and by minimizing the number of hops by using primarily ISX providers. Prior attempts to use the 15 internet for WANs have failed because the data paths were not controlled, the bandwidth was oversubscribed or in any fashion insufficient causing unacceptable latency and delays. This caused unpredictable latency which is very undesirable for multimedia video and audio traffic. Only light users with small amounts of non time sensitive data were able to use the 20 internet successfully as a WAN. The AlterWAN network structure uses a set of known high bandwidth, usually fiber optic, links between major domestic and international cities and couples these data paths with dedicated point-to-point or frame relay circuits run locally from the "nearest" participating ISX/ISP (sometimes it is not the physically nearest ISX but is the nearest ISX with a high bandwidth line to a key city that is participating) to the 25 customer site. The unique aspects are forcing the participating routers to stitch together known high bandwidth data paths with a minimum number of hops to high bandwidth dedicated local loop connections and encrypting all AlterWAN traffic for privacy.

Figure 4 is block diagram of a typical AlterWAN network for an international corporation with multiple international locations in the U.K., Germany, France and Japan with a headquarters in the U.S. Suppose one of workstations 78 through 82 on LAN 84 in the 30 U.K. site 96 wants to have access to server 86 on LAN 88 at the U.S. headquarters. Workstations 78 generates an IP packet that gets encapsulated into an Ethernet or other LAN packet addressed to the firewall 90. The firewall looks up the IP address in its tables and

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determines that the packet is addressed to an AlterWAN IP address in the U.S. headquarters. It then encrypts the payload portion of the packet using the prearranged key for the tunnel to the destination. The encrypted packet payload is sent through the “private tunnel” from the U.K. firewall 90 to the U.S. site firewall 92. Network address translation unit converts any
5 IP addresses that conflict with private IP addresses owned by some other company to one IP address on the untrusted interface given by the participating ISX. Firewalls can handle both NAT addressing and transparent addressing, but that is not relevant to the invention.

After encryption, the AlterWAN packet is forwarded to router 98 at the U.K. site 96. This router examines every packet and based on the routing tables forwards packets to the
10 next ISX. In this case, the router will only receive packets from the firewall if they were not for the local LAN. At this time, AlterWAN packets and conventional IP packets are equal, but AlterWAN traffic has “designed in” efficient routing paths to the destination points with the ISX/ISP connected by dedicated local loop line 100 that couples the router to the first participating ISX provider within internet cloud 102 via a known internal or external
15 channel service unit. The router in the first participating ISX within the internet cloud receives the AlterWAN packets and routes them along the predetermined private tunnel data path that has been preplanned to use the natural routing table (unless a special case requires additional special routes). This process continues at each router of each ISX along
the private tunnel to the U.S. site 106. The last participating ISX along the private tunnel is
20 represented by switch 104. This switch has all AlterWAN packets destined for this location passing therethrough and may be used to keep track of traffic levels for purposes of billing. Billing can be based on fixed monthly connections and/or billing with a base fee and usage
fee. Collection of the information to generate billing on base fee plus usage is from each
location requiring such.

From switch 104, AlterWAN packets are routed to firewall 92 at the customer U.S.
site where they are decrypted and sent to router 108 which outputs the packets onto LAN 88
where they are received and processed by server 86. Non AlterWAN packets routed by
switch 104 to firewall 110 are either replies to general internet activity initiated on LAN
88 or outside traffic requests intended for the web servers 114 and 116 on the firewall
30 DMZ. Any other traffic would be rejected by the firewall. These packets are not encrypted,
and after the firewall 110 processes them, they are routed to a LAN hub 112 and sent from
there to a web server 114 and another web server 116.

AlterWAN packets that originate at the U.K. or one of the other international sites and are addressed to another international site never go to switch 104. Instead an IP packet originating at, for example, the U.S. site and addressed to a device on the LAN at the French site, get routed through a private tunnel that extends from the U.K. firewall 90 to the
5 French firewall 91. Thus, these packets never pass through switch 104.

Although the invention has been disclosed in terms of the preferred and alternative embodiments disclosed herein, those skilled in the art will appreciate possible alternative embodiments and other modifications to the teachings disclosed herein which do not depart from the spirit and scope of the invention. All such alternative embodiments and other
10 modifications are intended to be included within the scope of the claims appended hereto.

Appendix A is a typical list of configuration commands for the firewall at the headquarters site of a typical AlterWAN to establish a private tunnel through the internet from the headquarters to a destination site firewall including establishment of the IP address of the first ISX in the tunnel. Appendix B is a typical list of configuration commands for the destination site firewall at the other end of the private tunnel. Appendix C is a typical list of configuration commands to configure the router at the headquarters site. Appendix D is a typical list of configuration commands to configure the router at the destination site.
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Although the invention has been disclosed in terms of the preferred and alternative embodiments disclosed herein, those skilled in the art will appreciate possible alternative embodiments and other modifications to the teachings disclosed herein which do not depart from the spirit and scope of the invention. All such alternative embodiments and other
20 modifications are intended to be included within the scope of the claims appended hereto.

What is claimed is:

- 1 1. A wide area network using the internet as a backbone, comprising:
 - 2 a first dedicated line coupled to a first participating ISX/ISP provider of
3 internet access;
 - 4 a source router having a channel service unit having an output coupled to said
5 first dedicated line;
 - 6 a source firewall circuit having a first port for coupling directly or through
7 a local area network to a first device for which communication over said wide area
8 network (hereafter WAN) is desired, and having a WAN interface coupled to said
9 source router directly or through a local area network, said source firewall
10 functioning to encrypt the payloads of downstream WAN packets being transmitted
11 via the WAN interface to said source router using any encryption method having a
12 user definable key or keys, and for decrypting the payloads of any incoming upstream
13 WAN packets arriving from said source router via said WAN interface using the same
14 encryption method and user definable key or keys that were used to encrypt the
15 outgoing WAN packets;
 - 16 one or more routers of other participating ISX/ISP providers of internet
17 services including a router at an endpoint participating ISX/ISP provider, said
18 routers functioning to implement a predetermined private tunnel data path coupling
19 a router of said first ISX/ISP to a router of said endpoint participating ISX/ISP
20 provider through said routers of said participating ISX/ISP providers;
 - 21 a destination router including a channel service unit coupled to or part of said
22 destination router, said destination router coupled through said channel service unit
23 and a second dedicated line to said router of said endpoint ISX/ISP provider;
 - 24 a destination firewall circuit having a WAN interface coupled to said
25 destination router directly or through a local area network and having a second port
26 for coupling directly or through a local area network to a device for which
27 communication across said wide area network is desired, said firewall functioning to
28 encrypt the payloads of upstream WAN packets being transmitted through said WAN
29 interface to said destination router for transmission to said source router via said
30 private tunnel using the same encryption method used by said source firewall and the

31 same user definable key or keys used by said source firewall circuit, and for
32 decrypting any incoming packets from said source router arriving from said
33 endpoint participating ISX/ISP provider using the same encryption protocol used by
34 said source firewall and the same user definable key or keys used by said source
35 firewall circuit and transmitting the decrypted packets to said second device.

1 2. A process for launching downstream AlterWAN packets addressed to an AlterWAN
2 destination into a private tunnel coupling two AlterWAN destinations using the internet as a
3 backbone and for launching non-AlterWAN packets into a normal internet traffic routing
4 data path, comprising the steps:

5 receiving at a source firewall an incoming downstream wide area network
6 packet from a workstation or other device at a first customer location said incoming
7 downstream wide area network packet being either addressed to an AlterWAN
8 destination or not an AlterWAN packet;

9 at said source firewall, using the destination address in said incoming
10 downstream wide area network packet to determine if said packet is addressed to an
11 AlterWAN destination coupled to said source firewall by a private tunnel using the
12 internet as a backbone (hereafter referred to as an AlterWAN packet) or is addressed
13 to some non-AlterWAN website or location on the internet (hereafter referred to as a
14 non-AlterWAN packet);

15 if said packet is an AlterWAN packet, encrypting at said source firewall the
16 payload portion thereof and forwarding the encrypted AlterWAN packet to a source
17 router;

18 if said packet is a non-AlterWAN packet, at said source firewall, forwarding
19 said non-AlterWAN packet to said source router without encrypting the payload
20 portion thereof;

21 at said source router, converting both said AlterWAN packets and said non-
22 AlterWAN packets into signals suitable for transmission on a dedicated telephone line
23 or other transmission medium coupling said source router to a specially selected
24 first ISX/ISP provider and transmitting said signals to said specially selected
25 ISX/ISP provider, said specially selected ISX/ISP provider being selected either
26 because their routing tables are such that AlterWAN packets will naturally be routed

27 along high bandwidth, low hop-count data paths to the next ISX/ISP provider in said
28 virtual private network or because the routing tables of the router of said first
29 ISX/ISP provider have been altered to insure that AlterWAN packets get routed along
30 high bandwidth, low hop-count data paths to the next ISX/ISP provider along said
31 private tunnel.

1 3. An apparatus comprising:

2 a dedicated data path for coupling to a specially selected first participating
3 ISX/ISP provider of internet access;

4 a firewall circuit having a first port for coupling directly or through a local
5 area network to one or more devices for which communication over a wide area
6 network using the internet as a backbone is desired, and having a second port, said
7 firewall functioning to use the destination addresses in the headers of each packet
8 received from said one or more devices to distinguish between AlterWAN packets
9 which are packets addressed to destination devices coupled to said firewall circuit via
10 a private tunnel through the internet, and conventional packets which are packets not
11 addressed to destination devices coupled to said firewall circuit via a private tunnel
12 through the internet, said firewall circuit functioning to encrypt the payloads of
13 outgoing AlterWAN packets using one or more predetermined keys and an encryption
14 algorithem, and sending said encrypted AlterWAN packets to said source router via
15 said second port, and functioning to forward any conventional packets to said source
16 router, and functioning to decrypt any incoming AlterWAN packets arriving from
17 said source router using the the same encryption algorithms and one or more
18 predetermined keys which were used to encrypt the packets at the location from
19 which they were sent;

20 a source router having an input coupled to said second port of said firewall
21 circuit either directly or by a local area network connection, and having a channel
22 service unit having an output coupled to said dedicated data path, said channel service
23 unit functioning to convert digital data packets received from said firewall circuit
24 into signals suitable for transmission over whatever type of transmission medium is
25 selected for said dedicated data path, and for converting signals received from said
26 dedicated data path into data packets, said source router for transmitting both

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27 AlterWAN and non-AlterWAN packets over said dedicated data path to said specially
28 selected first participating ISX/ISP provider where AlterWAN packets will be routed
29 via said private tunnel and specially selected ISX/ISP providers to their destination
30 and non-AlterWAN packets will be routed along paths on the internet other than said
31 private tunnel.

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1 4. A method of designing and implementing a wide area network using the internet as
2 a backbone, comprising the steps:

3 1) selecting source and destination sites that have devices that need to be
4 connected by a wide area network;

5 2) examining the ISX/ISP internet service providers that exist between said
6 source and destination sites and selecting two or more of such ISX/ISP providers
7 through which data passing between said source and destination sites will be routed,
8 said selection being based upon how many hops the routers at those sites will cause
9 packets travelling between said source and destination sites to take and whether the
10 average available bandwidth of the data paths along which the packets travelling
11 between said source and destination sites will travel is substantially greater than the
12 worst case bandwidth consumption of traffic between said source and destination
13 sites;

14 3) coupling a source firewall to the devices at said source site and
15 configuring said firewall to examine the destination addresses of packets received
16 from said devices at said source site and encapsulate each packet addressed to any
17 device at said destination site in an internet protocol packet, hereafter referred to as
18 an AlterWAN packet, said AlterWAN packet having as its destination address the
19 address of an untrusted port of a destination firewall at said destination site and
20 having the original IP packet as its payload, said source firewall being configured to
21 encrypt the payload portions of all said AlterWAN packets using a predetermined
22 encryption algorithm and one or more encryption keys but not to encapsulate or
23 encrypt the payload portions of any packets received from said devices at said source
24 site which are not addressed to any device at said destination site, and configuring
25 said source firewall to recognize any incoming AlterWAN packets which have as their
26 destination addresses the IP address of the untrusted side of said source firewall and

27 to strip off the AlterWAN packet headers and decrypt the payload portion of each said
28 AlterWAN packet to recover the original IP packet transmitted from said destination
29 site using the same encryption algorithm and the same encryption key or keys used to
30 encrypt the payload portions of said AlterWAN packets at said destination site and for
31 outputting said recovered the original IP packet to said devices at said source site,
32 said source firewall having an untrusted port;

33 4) coupling a source router to receive said encrypted and non-encrypted
34 packets from said untrusted port of said source firewall and to convert them in a
35 channel service unit to signals suitable for transmission over a first dedicated local
36 loop connection;

37 5) contracting to establish said first dedicated local loop connection between
38 the output of said source router at which said signals appear and a first participating
39 ISX/ISP provider in the group of ISX/ISP providers selected in step 2;

40 6) providing a destination router at said destination site having a channel
41 service unit which functions to receive from a second dedicated local loop connection
42 downstream signals encoding both encrypted AlterWAN packet and conventional IP
43 packets and converting said signals back into the original digital packet form and
44 outputting the recovered downstream packets at a firewall port, and said destination
45 router configured to receive upstream AlterWAN and conventional packets and
46 convert them into signals suitable for transmission on said second dedicated data path
47 coupling said destination router to an endpoint participating ISX/ISP provider in the
48 group of ISX/ISP providers selected in step 2 and transmitting said signals on said
49 second dedicated local loop connection;

50 7) contracting to provide a second dedicated local loop connection connecting
51 the input of said destination router to said endpoint participating ISX/ISP provider,
52 said second dedicated local loop connection having sufficiently high bandwidth to
53 handle the worst case traffic volume;

54 8) providing a destination firewall having an untrusted port having an IP
55 address coupled to said firewall port of said destination router to receive said
56 recovered digital packets, and configuring said destination firewall to recognize as
57 AlterWAN packets incoming recovered packets having as their destination address the
58 IP address of said destination firewall untrusted input port and to strip off the

5 9 AlterWAN packet header and decrypt the payload portion of said AlterWAN packet
6 0 using the same encryption algorithm and encryption key or keys that were used to
6 1 encrypt the packet at said source firewall, and configuring said destination firewall
6 2 to output the decrypted packets at an output coupled to devices at said destination site,
6 3 and configuring said destination firewall to examine the destination addresses of
6 4 upstream IP packets received from said devices at said destination site and
6 5 encapsulate each upstream IP packet addressed to any device at said source site in
6 6 another IP packet, hereafter referred to as an AlterWAN packet, said AlterWAN
6 7 packet having as its destination address the IP address of an untrusted port of said
6 8 source firewall at said source site and having the original IP packet as its payload,
6 9 said destination firewall being configured to encrypt the payload portions of all said
7 0 AlterWAN packets using a predetermined encryption algorithm and one or more
7 1 encryption keys but not to encapsulate or encrypt the payload portions of any IP
7 2 packets received from said devices at said destination site which are not addressed to
7 3 any device at said source site (hereafter referred to as conventional packets), and
7 4 said destination firewall configured to transmit said encrypted AlterWAN packets and
7 5 said conventional packets to said destination router via said untrusted port.

1 5. A wide area network using the internet as a backbone, comprising:
2 a first dedicated line coupled to a first participating ISX/ISP provider of
3 internet access;
4 a source router having a channel service unit having an output coupled to said
5 first dedicated line;
6 a source firewall circuit having a first port for coupling directly or through
7 a local area network to a first device for which communication over said wide area
8 network (hereafter WAN) is desired, and having a WAN interface coupled to said
9 source router directly or through a local area network, said source firewall
10 functioning to encrypt the payloads of downstream WAN packets being transmitted
11 via the WAN interface to said source router using a first encryption method having a
12 first set of user definable keys which may be only one key, and for decrypting the
13 payloads of any incoming upstream WAN packets arriving from said first
14 participating ISX/ISP using a second encryption method which is different than said

PATENT

15 first encryption method and a second set of user definable keys which are different
16 than the first set of user definable keys were used to encrypt the downstream WAN
17 packets;

18 one or more routers of other participating ISX/ISP providers of internet
19 services including a router at an endpoint participating ISX/ISP provider, said
20 routers functioning to implement a predetermined private tunnel data path coupling
21 a router of said first ISX/ISP to a router of said endpoint participating ISX/ISP
22 provider through said routers of said participating ISX/ISP providers;

23 a destination router including a channel service unit coupled to or part of said
24 destination router, said destination router coupled through said channel service unit
25 and a second dedicated line to said router of said endpoint ISX/ISP provider;

26 a destination firewall circuit having a WAN interface coupled to said
27 destination router directly or through a local area network and having a second port
28 for coupling directly or through a local area network to a device for which
29 communication across said wide area network is desired, said destination firewall
30 functioning to encrypt the payloads of upstream WAN packets being transmitted
31 through said WAN interface to said destination router for transmission to said source
32 router via said private tunnel using the same encryption method and user definable
33 key or keys used by said source firewall to decrypt upstream WAN packets, and for
34 decrypting any incoming downstream WAN packets from said source router arriving
35 from said destination router via the router of said endpoint participating ISX/ISP
36 provider using the same encryption method and encryption key or keys used by said
37 source firewall to encrypt downstream WAN packets and transmitting the decrypted
38 packets to said second device.

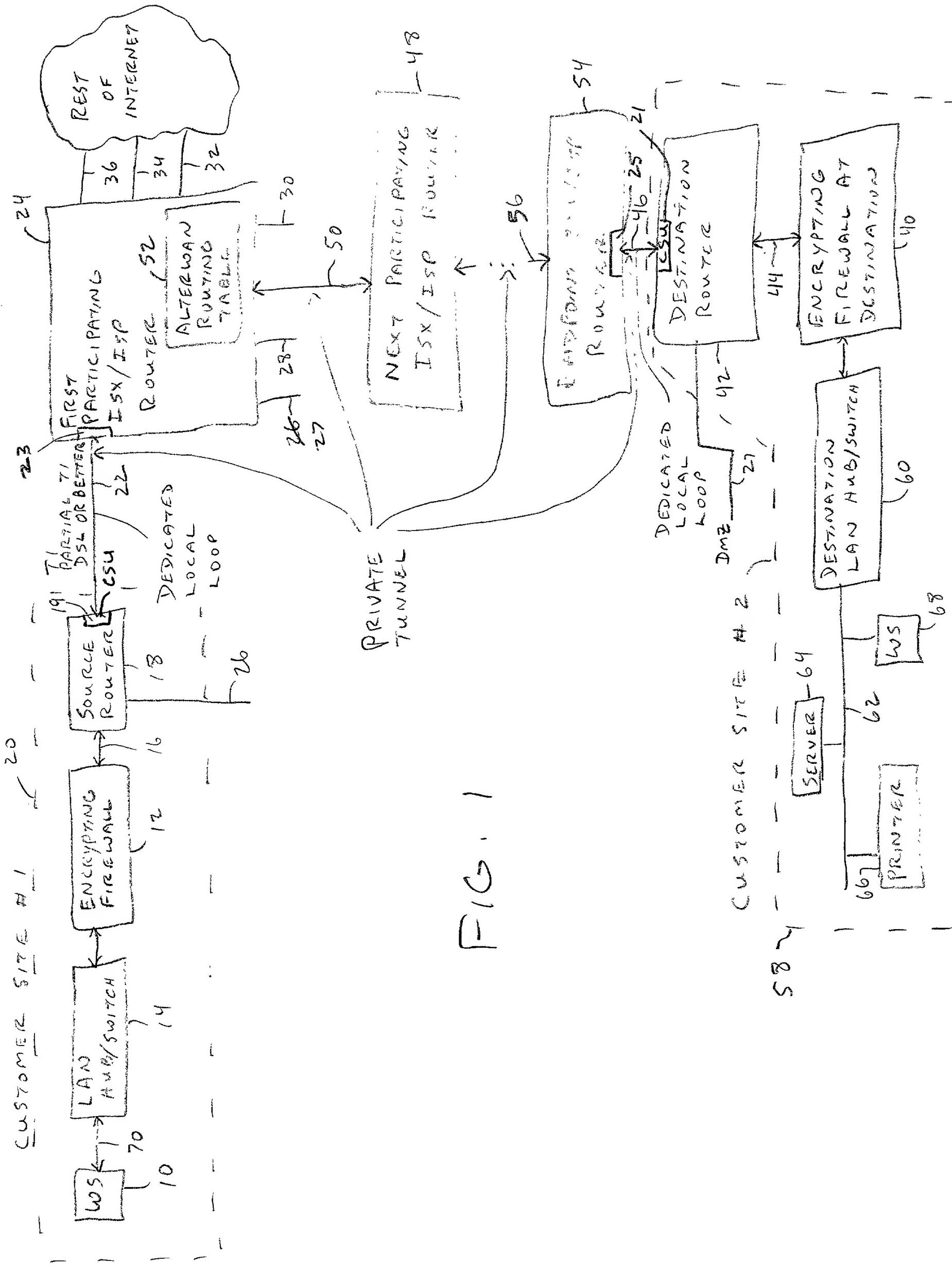
ABSTRACT

A wide area network using the internet as a backbone utilizing specially selected ISX/ISP providers whose routers route AlterWAN packets of said wide area network along private tunnels through the internet comprised of high bandwidth, low hop-count data paths. Firewalls are provided at each end of each private tunnel which recognize IP packets addressed to devices at the other end of the tunnel and encapsulate these packets in other IP packets which have a header which includes as the destination address, the IP address of the untrusted side of the firewall at the other end of the tunnel. The payload sections of these packets are the original IP packets and are encrypted and decrypted at both ends of the private tunnel using the same encryption algorithm using the same key or keys.

I hereby certify that this correspondence as being deposited with the United States Postal Service as express mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington D.C., 20231, on July 10
182000 Express Mail Receipt No. EM028923504US

JULY 10, 2000
Date of Signature

Ronald C. Fisch



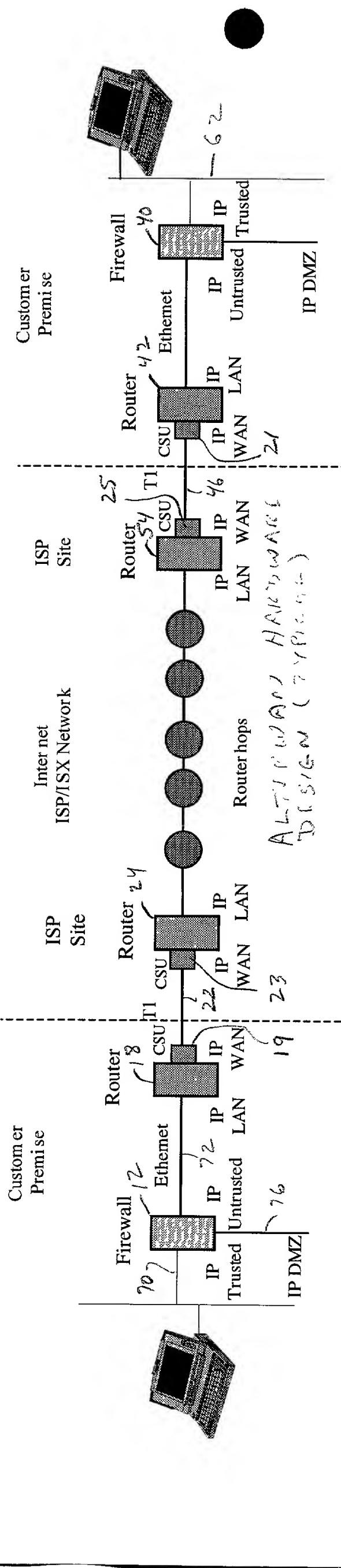


FIG. 2

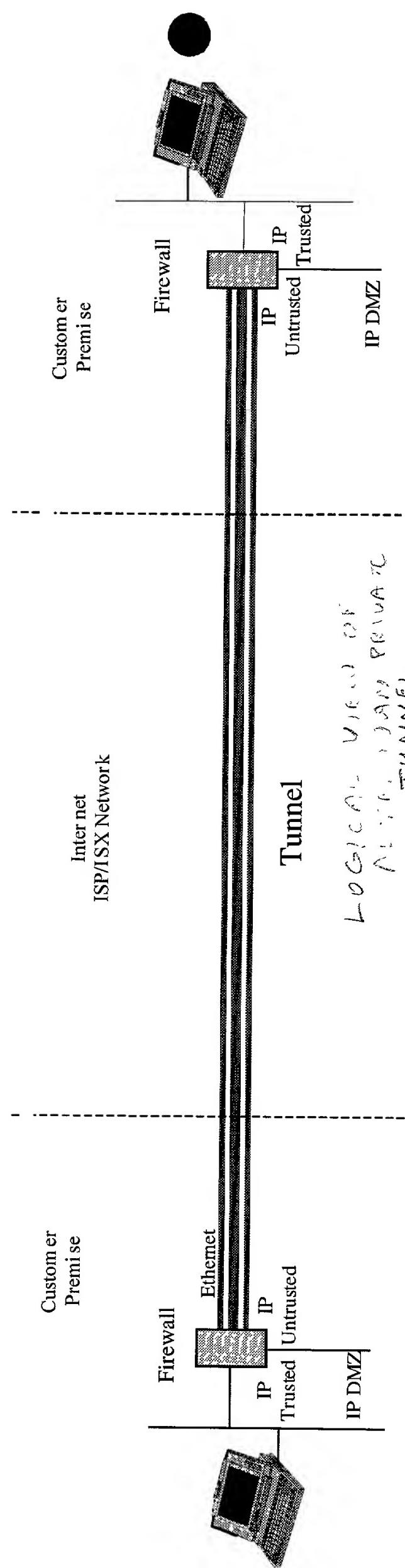


FIG. 3

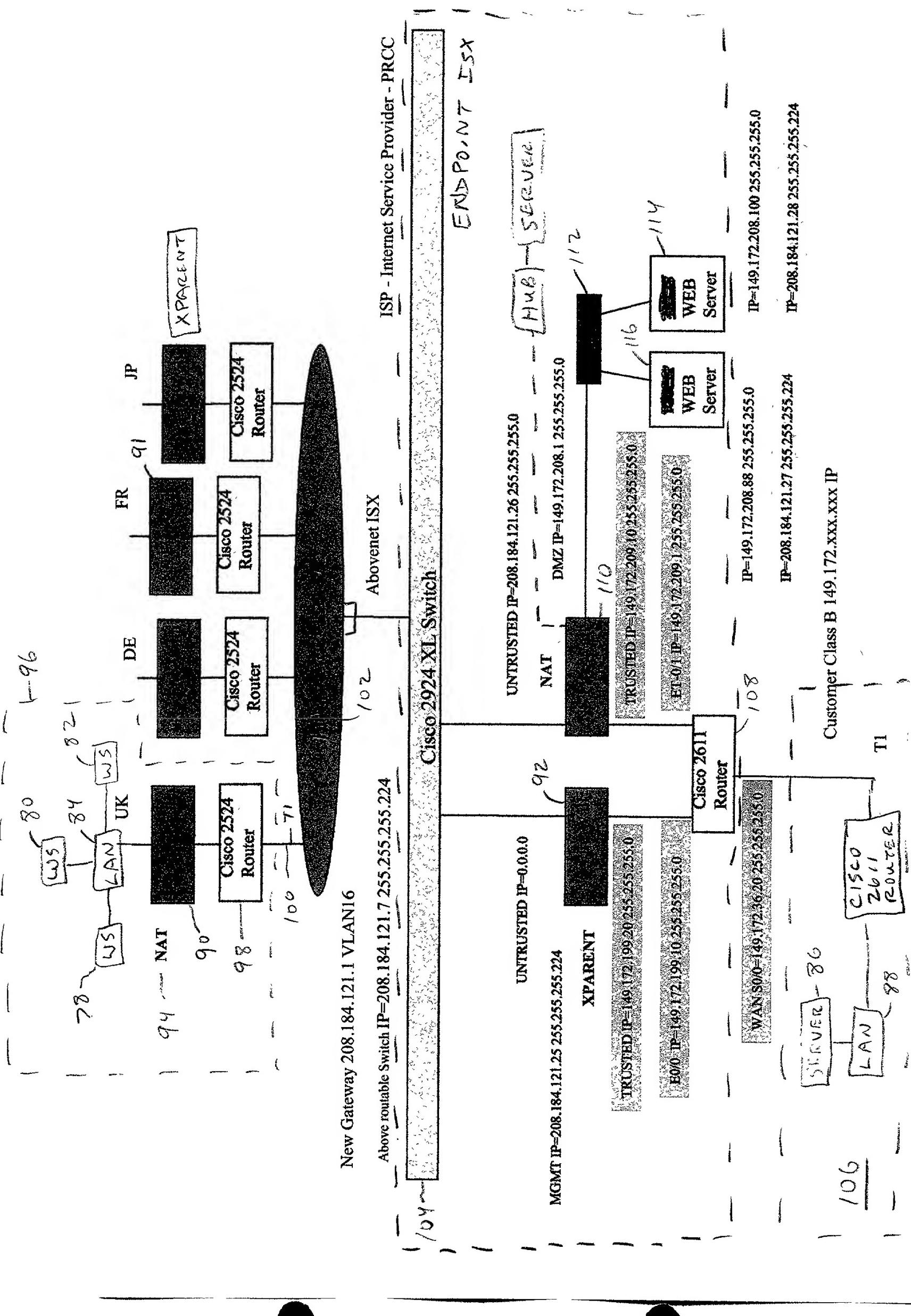


Fig. 4

DECLARATION FOR PATENT APPLICATION

Inventor(s): Richard D. Haney
Docket No. PRC-001

As a below-named inventor, I (We) hereby declare that:

My correct residence, post office address and citizenship are stated below next to my name.

I believe myself to be the original, first and sole inventor (if only one name is listed below) or an original and first joint inventor (if more than one name is listed below) of the subject matter which is disclosed and claimed and for which a patent is sought on the invention entitled:

WIDE AREA NETWORK USING INTERNET WITH HIGH QUALITY OF SERVICE

The specification of this subject matter:

- is attached hereto.
- was filed on _____
was assigned serial No. _____
which was amended on _____.

I hereby state that I have reviewed and understand the contents of the above identified patent application, including the claims, as amended by any amendment(s) referred to above. I believe the subject matter claimed in the above-identified application to be new and to be unobvious to persons of ordinary skill in the art in view of the prior art of which I am aware. I further hereby state that the specification of the above identified patent application adequately describes how to make and use the claimed invention, and further that it sets forth the best mode for practicing the invention known to me as of the date that the application was filed. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 C.F.R. 1.56. I further acknowledge the duty to disclose information known to me to be material under 37 C.F.R. 1.56 to the examination of the claims in any continuation-in-part application filed under the conditions specified in 35 U.S.C. Section 120 which became available between the filing date of the prior application or the national or PCT international filing date and the filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Application No.	Country	Filing Date	Priority Claimed
-----------------	---------	-------------	------------------

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in these prior United States application(s) in the manner provided by 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

Application No.	Filing Date	Status (Issued, Pending, Abandoned)
-----------------	-------------	-------------------------------------

FULL NAME OF INVENTOR	FIRST Name RICHARD	MIDDLE Initial(s) D.	LAST Name HANEY	
RESIDENCE AND CITIZENSHIP	City UNION CITY	State or Foreign Country CALIFORNIA, U.S.A.	Country of Citizenship U.S.A.	
POST OFFICE ADDRESS	Number and Street 4709 MICHELLE WAY	City UNION CITY	State or Country CALIFORNIA	Zip Code 94587

I hereby appoint the following attorney to prosecute this application and to transact all business in the United States Patent and Trademark Office connected with this application and all continuations, divisional and continuations-in-part of this application and to transact all business in all foreign patent offices for all foreign counterparts of this patent application or any divisional, continuation, continuation-in-part application or any PCT application arising out of this patent application or claiming priority of this patent application:

Ronald C. Fish (Reg. Number 28,843)

Address all telephone calls to Ronald Craig Fish at telephone no. (408) 778-3624
 Address all correspondence to Ronald Craig Fish

FALK & FISH
 Post Office Box 2258
 Morgan Hill, California 95038, U.S.A.
 FAX No. (408) 776-0426

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Signature of Inventor

7-10-2000

Date

```
NS100-HQ-NAT-> get conf
Total Config size 6229:
set url server 0.0.0.0 15868 10
set url message "NetScreen and NetPartners WebSENSE have been set to block this site."
set url msg-type 1
set url config disable
set auth type 0
set auth timeout 20
set admin name admin
set admin password admin
set admin sys-ip 0.0.0.0
set interface trust bandwidth 10000
set interface untrust bandwidth 10000
set interface dmz bandwidth 10000
set interface trust ip 149.172.209.10 255.255.255.0
set interface untrust ip 208.184.121.26 255.255.255.224
set interface dmz ip 149.172.208.1 255.255.255.0
set interface trust phy half 10mb
set interface untrust phy half 10mb
set interface trust ping
set interface untrust ping
set interface dmz ping
set interface trust mng
set interface untrust mng
set interface trust gateway 149.172.209.1
set interface untrust gateway 208.184.121.1
set flow tcp-mss
set hostname NS100-HQ-NAT
set address untrust "UK" 149.172.240.0 255.255.255.0
set address trust "PONG" 149.172.204.111 255.255.255.255 "pong.ikos.com"
set address dmz "Starfish" 149.172.208.88 255.255.255.255 "Rich Haney's Web Server"
set address dmz "s1" 149.172.208.100 255.255.255.255 "IKOS Public Web Server"
set address dmz "DMZ Subnet" 149.172.208.0 255.255.255.0
set service "RSH" protocol tcp src-port 0-1023 dst-port 514-514 group "remote"
set syn-alarm 1024
set syn-qsize 10240
set syn-timeout 20
set syn-threshold 200
set firewall tear-drop
set firewall syn-attack
unset firewall ip-spoofing
set firewall ping-of-death
set firewall src-route
set firewall land
set firewall icmp-flood
set firewall udp-flood
set firewall winnuke
set firewall port-scan
set firewall adr-sweep
set firewall default-deny
set syslog config 149.172.200.202 auth/sec auth/sec warn
set syslog enable
set vpn "HQ-UK" manual 4444 5555 gateway 195.14.71.226 esp 3des password letmein auth md5 password letmein
set mip 208.184.121.27 host 149.172.208.88 netmask 255.255.255.255
set mip 208.184.121.28 host 149.172.208.100 netmask 255.255.255.255
set policy todmz "Inside Any" "DMZ Any" "ANY" Permit log count
set policy fromdmz "DMZ Any" "Inside Any" "ANY" Permit log count
set policy fromdmz "DMZ Any" "MIP(208.184.121.27)" "ANY" Permit log
set policy incoming "Outside Any" "MIP(208.184.121.27)" "ANY" Permit log count
set policy incoming "Outside Any" "MIP(208.184.121.28)" "ANY" Permit log count
set policy outgoing "Inside Any" "UK" "ANY" Encrypt vpn tunnel "HQ-UK"
set policy todmz "Outside Any" "DMZ Any" "DNS" Permit log count
```

```
set policy todmz "Outside Any" "DMZ Any" "FTP" Permit log count
set policy todmz "Outside Any" "DMZ Any" "HTTP" Permit log count
set policy todmz "Outside Any" "DMZ Any" "HTTPS" Permit log count
set policy todmz "Outside Any" "DMZ Any" "POP3" Permit log count
set policy todmz "Outside Any" "DMZ Any" "MAIL" Permit log count
set policy todmz "Outside Any" "DMZ Any" "PING" Permit log count
set policy outgoing "Inside Any" "MIP(208.184.121.27)" "ANY" Permit log
set policy outgoing "Inside Any" "MIP(208.184.121.28)" "ANY" Permit log
set policy outgoing "Inside Any" "Outside Any" "ANY" Permit log
set policy fromdmz "DMZ Any" "MIP(208.184.121.28)" "ANY" Permit log
set policy fromdmz "DMZ Any" "Outside Any" "ANY" Permit log count
set route 149.172.45.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.204.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.200.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.202.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.206.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.201.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.215.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.155.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.145.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.205.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
set route 149.172.170.0 255.255.255.0 interface trust gateway 149.172.209.1 metric 1
NS100-HQ-NAT->
```

IKOS-UK-> get conf
*Total Config size 1390:
set url server 0.0.0.0 15868 10
set url message "NetScreen and NetPartners WebSENSE have been set to block this site."
set url msg-type 1
set url config disable
set auth type 0
set auth timeout 20
set clock ntp
set admin format dos
set admin name admin
set admin password admin
set admin sys-ip 0.0.0.0
set admin mail alert
set admin mail server-ip 149.172.200.202
set admin mail mail-addr1 mark@ikos.com
set admin mail mail-addr2 jj@ikos.com
set admin mail traffic-log
set interface trust ip 149.172.240.1 255.255.255.0
set interface untrust ip 195.14.71.226 255.255.255.248
set interface dmz ip 195.14.71.233 255.255.255.248
set interface trust ping
set interface untrust ping
set interface dmz ping
set interface trust mng
set interface untrust mng
set interface untrust gateway 195.14.71.225
set hostname IKOS-UK
set ntp server 149.172.204.111
set ntp zone 5
set address untrust "HQ-UK" 149.172.209.10 255.255.255.0
set syn-threshold 200
set firewall tear-drop
set firewall syn-attack
unset firewall ip-spoofing
set firewall ping-of-death
set firewall src-route
set firewall land
set firewall icmp-flood
set firewall udp-flood
set firewall winnuke
set firewall port-scan
set firewall adr-sweep
set firewall default-deny
set vpn "HQ-UK" manual 5555 4444 gateway 208.184.121.26 esp 3des password letmein auth md5 password letmem
set policy outgoing "Inside Any" "HQ-UK" "ANY" Encrypt vpn-tunnel "HQ-UK"
set policy outgoing "Inside Any" "Outside Any" "ANY" Permit
set syslog config 149.172.200.202 auth/sec auth/sec warn
set syslog enable
IKOS-UK->

DESTINATION FIREWALL SETUP
APPENDIX B

```
PRCC-IKOS-T1#sh conf
Using 2095 out of 29688 bytes
!
version 11.3
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname PRCC-IKOS-T1
!
boot system flash 1:c2600-d-mz.113-6.T.bin
enable password 7 08324D401D18
!
ip subnet-zero
ip domain-list ikos.com
ip domain-list pacificresources.com
ip domain-name ikos.com
ip name-server 149.172.208.100
!
!
!
interface Ethernet0/0
 ip address 208.184.121.25 255.255.255.224
 ip broadcast-address 208.184.121.31
 ip mask-reply
 no ip directed-broadcast
 no ip mroute-cache
!
interface Serial0/0
 ip address 149.172.36.20 255.255.255.0
 ip broadcast-address 149.172.36.255
 ip mask-reply
 no ip directed-broadcast
 no ip mroute-cache
 no fair-queue
!
interface Ethernet0/1
 ip address 149.172.209.1 255.255.255.0
 ip broadcast-address 149.172.209.255
 ip mask-reply
 no ip directed-broadcast
 no ip mroute-cache
!
ip default-gateway 208.184.121.1
no ip classless
ip route 0.0.0.0 0.0.0.0 Ethernet0/0 208.184.121.1
ip route 149.172.0.0 255.255.0.0 Serial0/0 149.172.36.1 2
ip route 149.172.36.0 255.255.255.0 Serial0/0
ip route 149.172.145.0 255.255.255.0 Ethernet0/1 149.172.209.10 2
ip route 149.172.195.0 255.255.255.0 Ethernet0/1 149.172.209.10 2
ip route 149.172.204.0 255.255.255.0 Serial0/0 149.172.36.1
```

```
ip route 149.172.208.0 255.255.255.0 Ethernet0/1 149.172.209.10  
ip route 149.172.209.0 255.255.255.0 Ethernet0/1  
ip route 149.172.210.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.212.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.220.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.225.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.235.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.240.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 149.172.245.0 255.255.255.0 Ethernet0/1 149.172.209.10 2  
ip route 208.184.121.0 255.255.255.224 Ethernet0/0
```

!

```
no logging console
```

```
snmp-server community ikospub RO
```

```
snmp-server community ikospriv RW
```

!

```
line con 0
```

```
  exec-timeout 0 0
```

```
line aux 0
```

```
line vty 0 4
```

```
  exec-timeout 20 0
```

```
password 7 000A160300090509
```

```
login
```

!

```
no scheduler allocate
```

```
end
```

```
IKOS-UK#sh conf
* Using 972 out of 32762 bytes
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname IKOS-UK
!
no logging buffered
enable password uk-47587
!
ip subnet-zero
ip domain-name ikos.com
ip name-server 149.172.204.101
ip name-server 149.172.208.100
clock timezone est -11
clock summer-time edt recurring
!
!
!
interface Ethernet0
 ip address 195.14.71.225 255.255.255.248
 ip broadcast-address 195.14.71.239
 ip directed-broadcast
!
interface Serial0
 bandwidth 384
 no ip address
 ip directed-broadcast
 encapsulation ppp
 shutdown
!
interface Serial1
 bandwidth 384
 ip address 195.14.66.98 255.255.255.252
 ip directed-broadcast
!
ip classless
ip route 0.0.0.0 0.0.0.0 Serial1
!
snmp-server community public RO
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
transport input all
line vty 0 4
exec-timeout 20 0
password int!2getin
login
!
ntp clock-period 17179866
end
```

UK DESTINATION ROUTER SETUP
APPENDIX D